The K2 Extra-Galactic Survey (KEGS) Transient Survey

Ed Shaya
University of Maryland

Supernovae (SN) and Active Galactic Nuclei (AGN) vary on timescales of hours to months and are still shrouded in mysteries. We propose a Large K2 Program to monitor ~ 4,700 bright ($r < 18$ mag, $z < 0.08$) galaxies in Campaign 6 which should yield, about 4 to 9 extremely well-sampled light curves (LCs) of supernovae. To date, we have identified 6 supernovae events in our Kepler GO programs and also found that ~ 4% of galaxies observed by Kepler show AGN-like activity (variability at > 0.001% level). We plan to: A) Determine the types of companions to progenitors of SNe using features in the early ($t < 4$ days) LCs; B) Explore the explosion physics of SN Ia using subtle features during its rise ($t < 20$ days); C) Improve the calibration of SN Ia for measuring distances and dark energy by creating a sample of well measured SN Ia LCs with unprecedented detail. D) In nearby galaxies, look for fast ($t > 10$ day) and faint ($M < -15$) transients in a new range of parameter space provided only by K2; and E) Add significantly to the virtually unexplored low-Eddington regime of AGN.

What triggers a white dwarf to explode as a SN Ia is unsolved. Does it accrete from a companion star or does it merge with another WD? If it accretes from a companion star, shock emission, as the explosion hits the star, would be observable (Kasen 2010). That emission will be short lived and strongest from certain viewing angles, requiring a rapid observing cadence and several SNe before strong conclusions can be reached. With two SN Ia discovered by our previous Kepler monitoring of ~ 500 galaxies (Olling et al. 2015), tight constraints were placed on the systems. With a larger sample, we could determine what the progenitors of SN Ia are. Meanwhile, features due to the different explosion physics (detonation, deflagration, inwards-moving diffusion waves, etc) of Ia and core collapse SNe will be revealed. K2 allows us, for the first time, to test models that are more complicated than the simple "expanding fireballs."

Our program will improve the calibration of SN Ia's for cosmology by reducing uncertainties in distance measurements. By determining the key parameters needed for distance fitting (light-curve width, maximum, and the explosion time) on the scale of minutes rather than days, we can improve the precision of distances and dark energy as a function of redshift.

We will undertake a major, concurrent ground-based effort to observe the entire field every other day using SkyMapper and ATLAS Pathfinder. We will also coordinate multi-color photometry and spectra to classify the transients using PESSTO, and existing programs at Siding Spring, Lick, Gemini, and Keck. These data, coupled with high precision 30 min K2 data will have great legacy value.

In addition, in the nearby galaxies, this program will also be sensitive to LBV- and nova-like eruptions, tidal shredding of stars or other material by super-massive black holes, and other still unknown types of faint, fast transients.